Impact Assessment of Global Warming in the Lower Seyhan Irrigation Project, Turkey

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1. Introduction

According to simulation results by major general circulation models (GCM), precipitation and river runoff in the Mediterranean Region including the Seyhan River Basin in Turkey will decrease in the future.

This report provides results of an assessment of impacts of global worming on agricultural production in the Lower Seyhan Irrigation Project (LSIP).

2. Methodology

Using an integration water balance model IMPAM (Irrigation Management Performance Assessment Model), we simulated balance and crop growth in irrigated areas with ten years climate data in the present and 2070s, and discussed impacts of global warming based on results of the simulation. IMPAM can simulate water movement and crop growth with spatial (geographical) information such as landuse, facility arrangement and terrain in irrigated areas (Hoshikawa, et al. 2005), and it can be used for assessment of impacts at irrigation district level.

Climate data used in this study are NCEP reanalysis 1994 – 2003 RCM-down-scaled and pseudo warming climate data in 2070s by Kimura (2005).

3. Model application area and scenarios for simulation

From winter to spring, wheat is cultivated in 20% of the project area as of 2005. Cotton was the almost only summer crop in the LSIP before 1980s, however, it was replaced by maize by 2000 because of an economical reason. Cultivation of citrus is also increasing gradually since 1980s. Percentage of cultivation area of maize, cotton, citrus, vegetable, and watermelon in the command area of the LSIP are 45%, 9%, 13%, 4%, and 6% respectively in 2004.

Annual precipitation in the Lower Seyhan is around 700mm, and it falls mostly in winter. Therefore, summer crops such as maize and cotton in the LSIP are cultivated with water supply from two upstream reservoirs.

IMPAM was applied to a command area of a tertiary canal in Gazi WUA, about 90 ha. This area has 20 agricultural plots. As of 2005, eight of them are under citrus garden, maize is cultivated in five plots, and watermelon, vegetable and seedling are in the remains

Table 1 Scenarios for the simulations

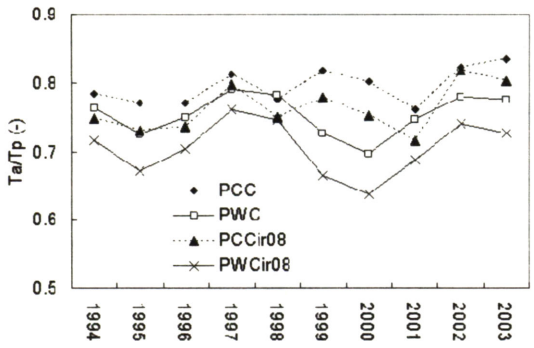
	Climate	Management	Abbreviation
A	Present	Present	PCC
B	2070s	Present	PWC
C	Present	80% of the present	PCCir08
D	2070s	80% of the present	PWCir08
E	Present	Maize monoculture	PCCmz
F	2070s	Maize monoculture	PWCmz

Tanaka (2006) calculated water-balance in 1994-2003 and 2070s with the same climate data that we used in this study, and presented that surface runoff will be significantly decreased in the Seyhan River basin in the future. Decrease of river runoff

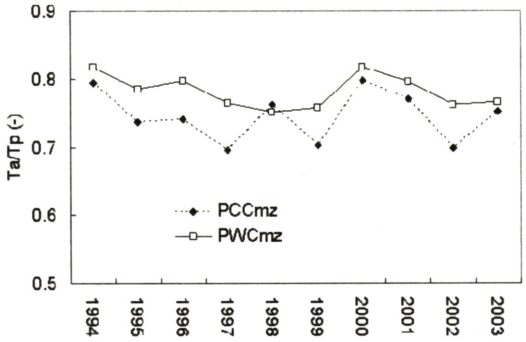
in the future might force the LSIP decrease its water withdrawal from the Seyhan River. Hence, a scenario in which net irrigation amount to each plot will be decreased by 20% was supposed (D in **Table 1**) in addition to a scenario in which only climate will change (B in **Table 1**). Crop pattern in the LSIP is changed drastically and quickly by socio-economic factors. These factors might give larger impacts to the LSIP than those of global warming in the short term. We supposed scenarios the present cropping pattern will be changed into maize monoculture (E and F in **Table 1**), and examined effects of cropping pattern change.

4. Simulation results

Under the present cropping pattern, although potential transpiration (Tp) will increase with progress of global warming, actual crop transpiration will decrease because of dryness of soil with less precipitation (**Fig. 1a**). This means that water stress of crops will increase in the future. In the case that amount of irrigation was decreased, more significant increase of water stress appeared. Citrus that occupies about a half of the simulation area at the present depends on precipitation in winter and is easily damaged by decrease of precipitation. On the other hand, water stress will decrease under maize monoculture (**Fig.1b**) as it mostly depends on irrigation.



(a) Present cropping pattern
(the present and decreased irrigation amount, and the present and 2070s climate)



(b) Maize mono culture
(the present and 2070s climate)

Fig.1 Ratio of actual to potential transpiration (Ta/Tp)

5. Conclusions

Progress of global warming will affect agricultural activities in the LSIP, and intensity of the effect will vary with cropping pattern. It might be difficult to cultivate citrus and winter wheat that depend on precipitation in winter in 2070s however farmers in the area could avoid damage on themselves through change of cropping pattern as they have been changing cropping pattern to catch up economic changes.

6. References

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